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Indian Standard

METHODS OF TEST FOR RUBBER LATEX

PART 2 DETERMINATION OF VISCOSITY

[RL : 2]

(First Revision)

UDC 678·4·031 : 532·13

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *December* 1987

AMENDMENT NO. 1 MARCH 2002
TO
IS 9316(PART 2) :1987 METHODS OF TEST FOR RUBBER LATEX

PART 2 DETERMINATION OF VISCOSITY

[RL:2]

(First Revision)

(*Page* 9, *clause* 3.3) — Substitute '25 ± 1°C' *for* '27°C'.

(*Page* 9, *clause* 5.1, *lines* 2 *and* 3) — Substitute '25 ± 1°C' *for* '27°C' and 27± 2°C'.

PCD 14)

Reprography Unit, BIS, New Delhi, India

Indian Standard

METHODS OF TEST FOR RUBBER LATEX

PART 2 DETERMINATION OF VISCOSITY

[RL : 2]

(First Revision)

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(*Continued on page* 13)

Indian Standard

METHODS OF TEST FOR RUBBER LATEX

PART 2 DETERMINATION OF VISCOSITY

[RL : 2]

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 2) (First Revision) was adopted by the Indian Standards Institution on 31 March 1987, after the draft finalized by the Rubber Sectional Committee had been approved by the Petroleum Coal and Its Related Products Division Council.

0.2 Test methods for rubber latex had been originally covered in the following Indian Standards:

For natural rubber latex:

IS : 3708 (Part 1)-1966*

IS : 3708 (Part 2)-1968†

For styrene butadiene rubber latex:

IS : 4511 (Part 1)-1967‡

Since some of the test methods covered in above standards were common, the concerned Committee had decided some years ago to unify and publish a separate series of methods of test which would be applicable to all types of latices — natural as well as synthetic. Accordingly, the following six test methods had been covered under IS : 9316:

---

*Methods of test for natural rubber latex: Part 1 Dry rubber content, sludge content, density, total alkalinity, KOH-number, mechanical stability, volatile fatty acid number, *p*H, total nitrogen, total copper, total iron, total manganese and total ash.

†Methods of test for natural rubber latex, Part 2.

‡Methods of test for styrene-butadiene rubber (SBR) latices: Part 1 Determination of dry polymer, *p*H, density, residual styrene, bound styrene and soap content.

IS : 9316 Methods of test for rubber latex:

Part 1-1979 Determination of surface tension
Part 2-1979 Determination of viscosity
Part 3-1979 Determination of coagulum content
Part 4-1979 Determination of total solids content
Part 5-1979 Drawing of samples
Part 6-1982 Determination of *p*H

0.2.1 As a result of further rethinking on the subject, it has now been decided to re-designate the test methods common to natural and synthetic rubber latices as RL series; test methods for natural rubber latex as NRL series and test methods for styrene-butadiene rubber latex as SBRL series. Consequently, test methods for rubber latex have been rationalized into the following three series:

a) IS : 9316 Unified methods of test applicable to both natural and synthetic rubber latices — RL series;

b) IS : 3708 Methods of test applicable to natural rubber latex — NRL series; and

c) IS : 4511 Methods of test applicable to styrene-butadiene rubber latex — SBRL series.

0.3 The existing Indian Standards under IS : 3708 (Parts 1* and 2†), IS : 4511 (Part 1‡) and IS : 9316 (Parts 1 to 6) are being gradually replaced by separate standards under the above three series, designated by the appropriate NRL, SBRL, or RL series, respectively.

0.3.1 The methods covered under NRL : 13, NRL : 14 and NRL : 15 of IS : 3708 (Part 1)-1966 are now being covered under the RL series in IS : 9316 (*under revision*).

0.4 In order to facilitate cross-reference, it has been decided to retain the original discrete NRL, SBRL and RL series numbers assigned to various test methods, in IS : 3708 (Parts 1* and 2†), IS : 4511 (Part 1‡) and IS : 9316 (Parts 1 to 6) in the revised Parts of IS : 3708, IS : 4511 and IS : 9316 respectively.

---

*Methods of test for natural rubber latex: Part 1 Dry rubber content, sludge content, density, total alkalinity, KOH-number, mechanical stability, volatile fatty acid number, *p*H total nitrogen, total copper, total iron, total manganese and total ash.

†Methods of test for natural rubber latex, Part 2.

‡Methods of test for styrene butadiene rubber (SBR) latices: Part 1 Determination of dry polymer, *p*H, density, residual styrene, bound styrene and soap content.

0.4.1 For proper referencing of the existing test methods and the new methods under revision, a statement showing corresponding methods is given in Appendix A.

0.5 In preparing the above series, the need to align the test methods with the corresponding ISO Standards, DIS/DP wherever available has also been taken into account for updating the test methods. In the preparation of this standard, assistance has been derived from ISO 1652-1985 Rubber latex — Determination of viscosity, issued by the International Organization for Standardization (ISO).

0.6 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part 2) prescribes a method for the determination of the viscosity of both natural and synthetic rubber latices.

2. OUTLINE OF THE METHOD

2.1 The viscosity of a latex sample is determined by means of a viscometer which measures the torque produced on a specified spindle rotating at constant rotational frequency and at a low rate of shear while immersed to a specific depth in the latex. Measurements may be made on the undiluted latex or on the latex after dilution to a required total solids content.

3. APPARATUS

3.1 Viscometer† — It consists of an electric synchronous motor which drives, at a constant rotational frequency, a shaft to which spindles of different shapes and dimensions may be attached. The spindle is immersed in the latex to a specified depth and the drag on the spindle rotating in the latex causes a torque to be developed on the spindle shaft. The equilibrium torque developed is indicated by means of a pointer and scale which is calibrated in units from 0 to 100. Two instruments depending on the viscosity to be measured are to be used

---

*Rules for rounding off numerical values (*revised*).

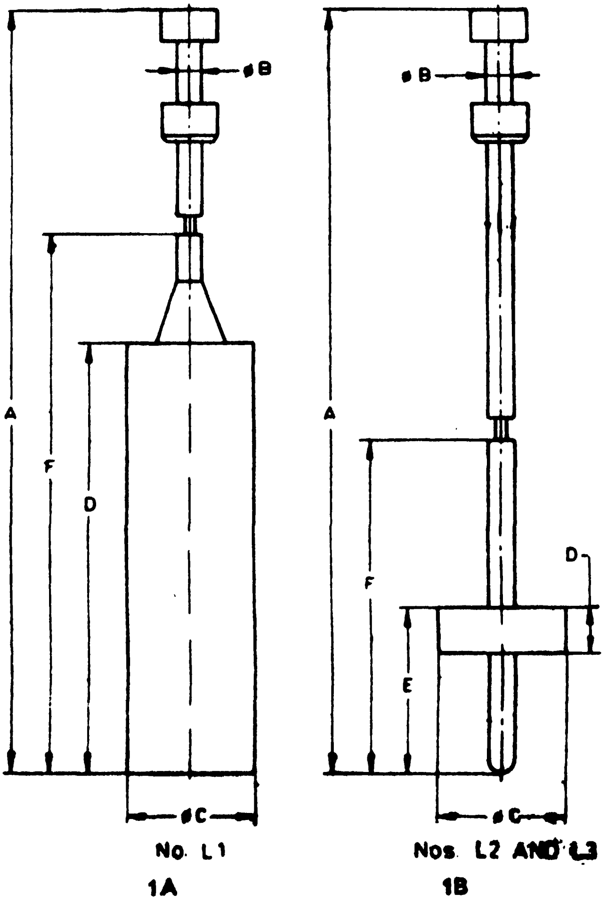
†Suitable instruments are obtainable from Brookfield Engineering Laboratories, Inc Stoughton, Mass 02072. Models LVF and LVT meet the requirements for the *L* instrument, and models RVF and RVT meet the requirements for the *R* instrument.

as follows:

a) The *L instrument* which uses a spring torque of 67·37 ± 0·07 μN.m (673·7 ± 0·7 dyne. cm) at full-scale deflection is applicable for viscosities up to 2 000 mPa.s (2 000 cP), and

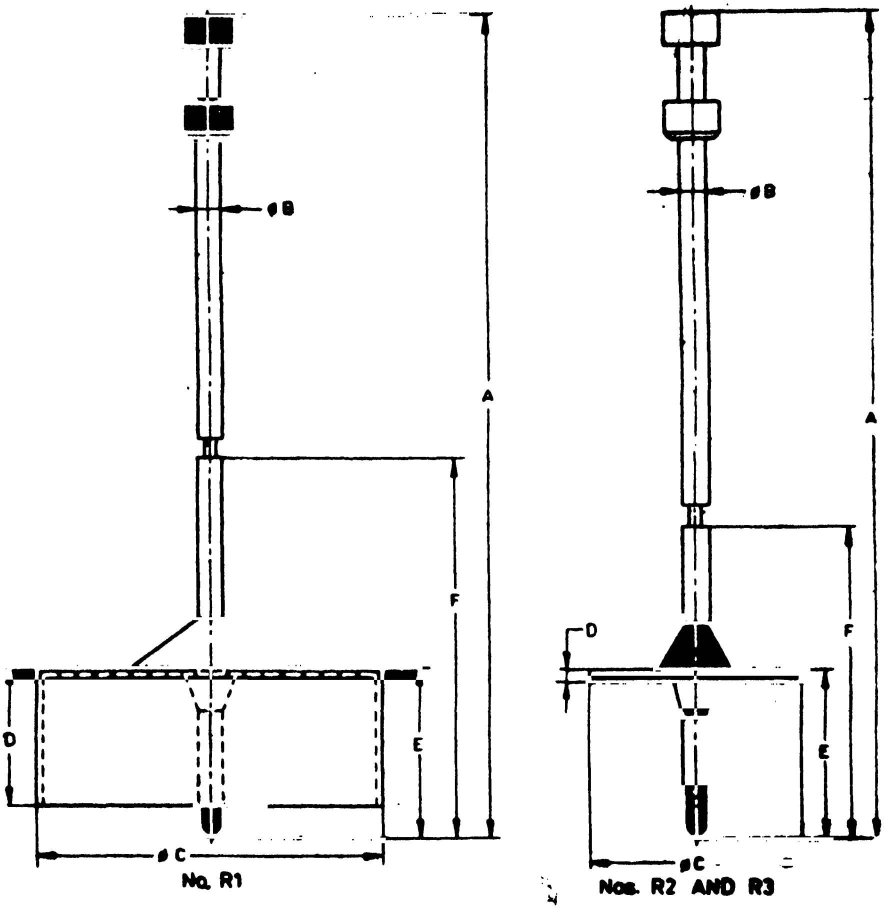
b) The *R instrument* which uses a spring torque of 718·7 ± 0·7 μN.m (7 187 ±7 dyne.cm) at full-scale deflection is applicable for viscosities above 200 mPa.s (200 cP).

The spindles shall be accurately made in accordance with Fig. 1 and to the dimensions given in Table 1.



1A 1B

Fig. 1 Spindles — *Contd*



1C 1D

FIG. 1 SPINDLES

TABLE 1 SPINDLE DIMENSIONS

(*Clauses* 3.1; and *Fig.* 1)

Spindle No.	*A* ± 1·3	*B* ± 0·03	*C* ± 0·03	*D* ± 0·06	*E* ± 1·3	*F* ± 0·15
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	mm	mm	mm	mm	mm	mm
L_1	115·1	3·18	18·84	65·10	—	81·0
L_2	115·1	3·18	18·72	6·86	25·4	50·0
L_3	115·1	3·18	12·70	1·65	25·4	50·0
R_1	133·3	3·18	56·26*	22·48†	27·0	61·1
R_2	133·3	3·18	46·93	1·57	27·0	49·2
R_3	133·3	3·18	34·69	1·65	27·0	49·2

*Wall thickness approximately 0·6 mm.

†Wall thickness approximately 1·0 mm.

3.1.1 A spirit level or bubble level shall be incorporated in the motor housing to indicate, with the spindle attached to the motor shaft, when the spindle is vertical. A guard shall be used to protect the spindle in operation. This shall consist of a rectangular bar of section approximately 9·5 mm × 3 mm, with the corners rounded, bent into a U. The upper ends of the vertical legs of the guard shall be securely attached to the motor housing but in such a way that the guard is removable for cleaning. The horizontal portion of the guard shall join the vertical legs of the guard through internal radii of approximately 6 mm. The perpendicular distance between the inner faces of the two vertical legs of the guard when the guard is securely attached to the motor housing shall be 31·8 ± 0·8 mm with the *L instrument* and 76·2 ± 0·8 mm with the *R instrument*. The perpendicular distance between the upper face of the horizontal portion of the guard and the bottom of the spindle shaft, when the guard is securely attached to the motor housing and when the spindle is attached to the motor shaft, shall be not less than 10 mm with the *L instrument* and not less than 4·5 mm with the *R instrument*.

Note — Digital type viscometer may also be used in place of dial-type viscometer.

3.2 Beaker — glass beaker of internal diameter at least 85 mm and capacity at least 600 ml.

3.3 Water-Bath — capable of being maintained at 27°C.

4. PREPARATION OF SAMPLE

4.1 Determine the total solids content of the latex in accordance with IS : 9316 (Part 4)-1979*, and then, if necessary, accurately adjust to the required value by the addition of distilled water or water of equivalent purity. Add the water slowly to the latex and stir the mixture gently for 5 min, taking care to avoid inclusion of air.

4.2 If the latex contains occluded air and has a viscosity of less than about 200 mPa.s (200 cP), remove the air by allowing the latex to stand for 24 h. If the latex contains occluded air and no other volatile component, and has a viscosity greater than about 200 mPa.s (200 cP), remove the air by allowing the latex to stand under vacuum until foaming ceases.

4.3 Should the presence of coagulum be noted, carefully strain the latex through a screen having square apertures with sides of approximately 500 μm.

5. PROCEDURE

5.1 Pour the sample into the beaker. Place the beaker in the water-bath, maintained at 27°C, and stir the sample gently until its temperature is 27 ± 2°C. Record the precise temperature. Immediately attach the spindle securely to the motor shaft and attach the guard securely to the motor housing of the viscometer. Carefully insert the spindle and guard into the sample, in such a way as to avoid air being trapped until the surface of the sample is at the mid-point of the groove on the spindle shaft. The spindle shall be placed vertically in the sample and in the centre of the beaker.

Select the rotational frequency of the instrument as follows:

L instrument: $60 \pm 0{\cdot}2\ \text{min}^{-1}$ ($1 \pm 0{\cdot}003\ \text{s}^{-1}$)

R instrument: $20 \pm 0{\cdot}2\ \text{min}^{-1}$ ($0{\cdot}333 \pm 0{\cdot}003\ \text{s}^{-1}$)

5.2 Switch on the viscometer motor and take the equilibrium reading to the nearest unit scale division, in accordance with the manufacturer's operating instructions. Twenty to thirty seconds may elapse before the equilibrium reading is attained.

5.3 Use the lowest numbered spindle able to record the viscosity.

---

*Methods of test for rubber latex: Part 4 Determination of total solids content.

6. EXPRESSION OF RESULTS

6.1 Calculate the viscosity of the latex, expressed in millipascal seconds (centipoises), using the appropriate factor obtained from Table 2.

TABLE 2 FACTORS NECESSARY TO CONVERT READING ON SCALE 0 TO 100 MILLIPASCAL SECONDS (CENTIPOISES)

SPINDLE No. (1)	FACTOR (2)
L_1	× 1
L_2 or R_1	× 5
L_3 or R_2	× 20
R_3	× 50

APPENDIX A

(*Clause* 0.4.1)

TABLE SHOWING CORRESPONDENCE OF THE VARIOUS METHODS OF TEST COVERED IN THE EXISTING IS : 9316 (PARTS 1 TO 5)-1979, IS : 9316 (PART 6)-1982, IS : 3708 (PART 1)-1966, IS : 3708 (PART 2)-1968, IS : 4511 (PART 1)-1967 *WITH* THE REVISION/PROPOSED REVISION OF IS : 9316, IS : 3708 AND IS : 4511

Existing Test Methods			Proposed Revisions		Remarks
Test Method	IS No.	Part (Series)	IS No.	Part (Series)	
(1)	(2)	(3)	(4)	(5)	(6)
RL Series					
Determination of surface tension	IS : 9316-1979	Part 1	IS : 9316	Part 1 (RL : 1)	
Determination of viscosity	IS : 9316-1979	Part 2	IS : 9316	Part 2 (RL : 2)	
Determination of coagulum content	IS : 9316-1979	Part 3	IS : 9316	Part 3 (RL : 3)	
Determination of total solids content	IS : 9316-1979	Part 4	IS : 9316	Part 4 (RL : 4)	Under revision
Drawing of samples	IS : 9316-1979	Part 5	IS : 9316	Part 5 (RL : 5)	
Determination of *p*H	IS : 9316-1982	Part 6	IS : 9316	Part 6 (RL : 6)	
Determination of total copper	IS : 3708-1966	Part 1 (NRL : 13)	IS : 9316	Part 7 (RL : 7)	
Determination of total iron	IS : 3708-1966	Part 1 (NRL : 14)	IS : 9316	Part 8 (RL : 8)	
Determination of total manganese	IS : 3708-1966	Part 1 (NRL : 15)	IS : 9316	Part 9 (RL : 9)	
NRL Series					
Determination of dry rubber content	IS : 3708-1966	Part 1 (NRL : 1)	IS : 3708-1985	Part 1 (NRL : 1)	
Determination of sludge content	IS : 3708-1966	Part 1 (NRL : 5)	IS : 3708-1985	Part 2 (NRL : 5)	
Determination of density	IS : 3708-1966	Part 1 (NRL : 6)	IS : 3708-1985	Part 3 (NRL : 6)	
Determination of total alkalinity	IS : 3708-1966	Part 1 (NRL : 7)	IS : 3708-1985	Part 4 (NRL : 7)	

(*Continued*)

Existing Test Methods			Proposed Revision		Remarks
Test Method	IS No.	Part (Series)	IS No.	Part (Series)	
(1)	(2)	(3)	(4)	(5)	(6)
Determination of KOH-number	IS : 3708-1966	Part 1 (NRL : 8)	IS : 3708-1985	Part 5 (NRL : 8)	
Determination of mechanical stability	IS : 3708-1966	Part 1 (NRL : 9)	IS : 3708-1985	Part 6 (NRL : 9)	
Determination of volatile fatty acid number	IS : 3708-1966	Part 1 (NRL : 10)	IS : 3708-1986	Part 7 (NRL : 10)	
Determination of total nitrogen	IS : 3708-1966	Part 1 (NRL : 12)	IS : 3708	Part 8 (NRL : 12)	
Determination of total ash	IS : 3708-1966	Part 1 (NRL : 16)	IS : 3708-1986	Part 9 (NRL : 16)	
Determination of boric acid	IS : 3708-1968	Part 2 (NRL : 17)	IS : 3708-1986	Part 10 (NRL : 17)	
Determination of magnesium	IS : 3708-1968	Part 2 (NRL : 18)	IS : 3708-1986	Part 11 (NRL : 18)	
SBRL Series					
Determination of dry polymer	IS : 4511-1967	Part 1 (SBRL : 1)	IS : 4511-1986	Part 1 (SBRL : 1)	
Determination of density	IS : 4511-1967	Part 1 (SBRL : 6)	IS : 4511-1986	Part 2 (SBRL : 6)	
Determination of volatile unsaturates	IS : 4511-1967	Part 1 (SBRL : 8)	IS : 4511	Part 3 (SBRL : 8)	
Determination of bound styrene	IS : 4511-1967	Part 1 (SBRL : 9)	IS : 4511	Part 4 (SBRL : 9)	
Determination of soap content	IS : 4511-1967	Part 1 (SBRL : 10)	IS : 4511	Part 5 (SBRL : 10)	
Determination of high-speed mechanical stability	—	—	IS : 4511	Part 6 (SBRL : 11)	

(*Continued from page* 2)

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Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane Angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 $kg.m/s^2$
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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